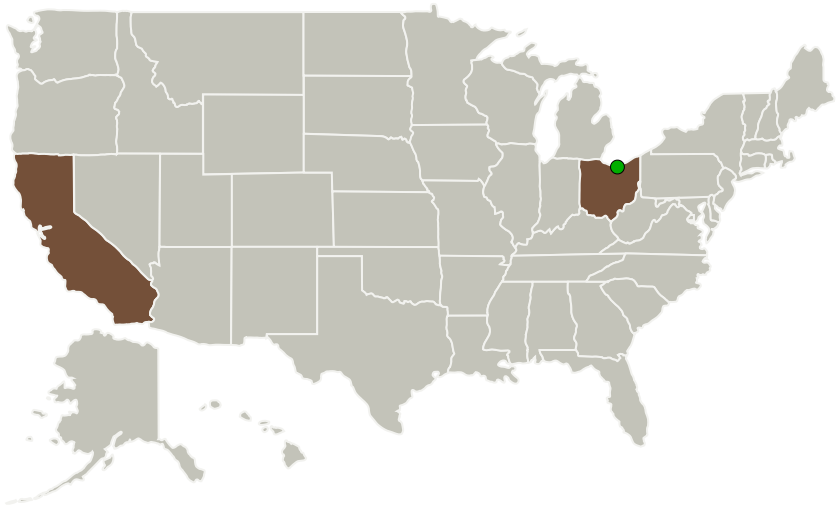
Mixed-Phase Ice Crystal and Droplet Characterization and Thermometry, Phase I

Completed Technology Project (2012 - 2012)

Project Introduction

This effort proposes to design, build, and demonstrate a new instrument for icing research and flight safety capable of discriminating liquid water from ice while simultaneously measuring the diameter, velocity, and temperature of droplets or the velocity and size for ice crystals. From these individual particle characteristics the total liquid water content (LWC) and the total water content (TWC) of the flow may be found. This non-intrusive, laser-based, point measurement diagnostic will operate in an off-axis, back scatter configuration at a range of working distances appropriate to characterize laboratory-scale experiments, icing tunnel flows, free jet test facilities, or flight conditions at altitude. The proposed instrument will apply phase-Doppler interferometry, polarization ratio phase discrimination, droplet rainbow thermometry, and cross-polarization imaging to each particle measured (see Part 4 for details on these techniques). This will provide joint measures of liquid/solid phase, velocity, diameter or particle size, and droplet temperature. Furthermore, there is redundancy built into the measurements. For instance, the droplet diameter can be measured both by phase-Doppler interferometry and by rainbow thermometry and all four measurement techniques can discriminate solid ice from liquid droplets. While no single instrument can measure all possible cloud droplets, the proposed instrument can be configured to measure droplets from as small as 3 μm to larger than 3 mm in diameter.

Primary U.S. Work Locations and Key Partners



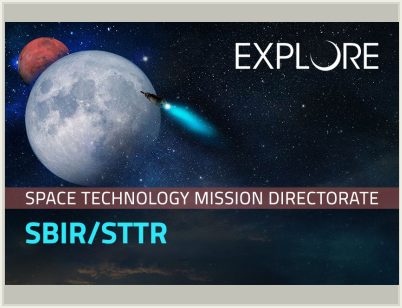


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Table of Contents

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Organizations Performing Work	Role	Type	Location
Artium Technologies	Lead Organization	Industry	Sunnyvale, California
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
California	Ohio

Project Transitions

February 2012: Project Start

August 2012: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137717)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Artium Technologies

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

William D Bachalo

Co-Investigator:

William Bachalo

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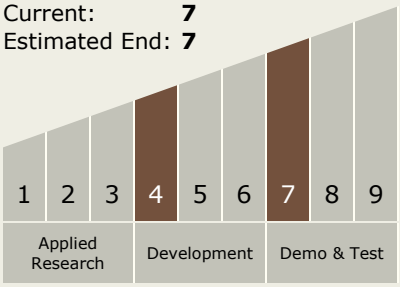
Completed Technology Project (2012 - 2012)

Technology Maturity (TRL)

Start: **4**
Current: **7**
Estimated End: **7**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.3 Aero Propulsion
    - TX01.3.11 Engine Icing

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System